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Occupational Health in Ontario

Volume 2, Number 3 July, 1981

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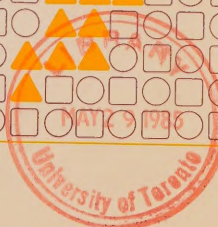
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*A New Emphasis in
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*Health Effects of
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Biphenyls*

*Occupational Health and
Safety for Small
Business*

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Occupational Health in Ontario

Volume 2, Number 3 July, 1981

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Examples

1. Lee WR, and Miles S. Postgraduate preparation for occupational medicine. *J Soc Occup Med* 1976; 26:115-119.
2. Department of Health and Social Security. Notes on the diagnoses of occupational diseases, rev ed 1972; London HMSO.
3. Gamble JF, and Battigelli MC. Epidemiology. In: Clayton GD and Clayton FE, eds. *Patty's industrial hygiene and toxicology*. New York: McGraw Hill, 1978; Vol 1; 113-116.

Two copies of both the manuscript and illustrations should be sent to:
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Toronto, Ontario
M7A 1T7

Correspondence

To the Editor

I would like to comment on the article written by Dr. M. Finkelstein, 'The Importance of Worker Compliance in the Use of Hearing Protectors'.¹

Although I found the article very illustrative and straightforward, there are points that should be corrected to prevent misunderstanding. They are:

1. The decibel (dB) scale is not logarithmic, but linear. The fact that the dB is a logarithmic relation does not change the linearity of a scale, where distances between 5, 15, 25 and 35 dB are an equal distance apart.

2. By definition²

Sound Level (SL) = $10 \log (P/P_0)^2$, dB and Intensity Level (IL) = $10 \log I/I_0$, dB where P = actual sound pressure

P_0 = reference pressure = 2×10^{-5} Pa

I = actual intensity

I_0 = reference intensity = 10^{-12} W/m²

Sound level and intensity level are two completely different magnitudes obviously and should not be mixed up.

3. The Equal-Energy Principle is accepted in Europe and used by the ISO,³ but its validity is questioned in North America up to the point that OSHA⁴ in the USA and the recently approved OHS Act 1978⁵ use the 5 dB exchange rate (reduction in dB each time the exposure is doubled). As a consequence, the maximum allowed sound levels per a daily exposure starting at 85 dBA per 8 hrs.

are different, as can be seen in the table below.

SL dB	Exposure Time (hs)	
	ISO	OHSA
85	8	8
88	4	
90		4
91	2	
94	1	
95		2
97	0.5	
100	0.25	1

4. By using the OHSA 5 dB exchange rate, the example of the hearing protector that provides 20 dB (we assume that this is 20 dBA) attenuation when worn during half of the shift, provides an equivalent protection of 4.5 dB (and not 3 dB as in the article).
5. By using the same principle, effective protection values from author's Table 1 becomes as follows:*

Time Worn	Effective Protection, dB
8 hours	20.0
8 hours less 5 min.	19.0
8 hours less 10 min.	18.0
8 hours less 15 min.	17.2
8 hours less 30 min.	15.2
7 hours	12.4
6 hours	8.7
4 hours	4.5

*Values obtained from

$$D = 100 \times \sum \frac{t_i}{T_i} \%$$

$$L_{\text{OSHA}} = 85 + 16.67 \frac{D}{100}$$

where D = Noise Dose
 t_i = Time of Exposure at
a Level L_i
 T_i = Total time of
exposure permitted by
OHS
Proposed Regulations
(6) at that level
 L_i

L_{OSHA} = Equivalent exposure level

6. Apart from the above, the article is very useful by pointing out the importance of wearing hearing protectors all the time while a person is exposed to hazardous noises.

A. Behar, P. Eng. DIC,
Safety Specialist —
Physical Agents,
Industrial Hygiene,
Central Safety Services,
Ontario Hydro,
Pickering, Ont.

References

¹Finkelstein M., The Importance of Worker Compliance in the Use of Hearing Protectors, Occupational Health in Ontario, 1980, Vol. 1 (4) 31-33.

²ANSI S1.1-1960 (R1971), Acoustical Terminology, American National Standard Institute, 1971.

³ISO R1999-1975, Assessment of Occupational Noise Exposure for Hearing Conservation Purposes. International Organization for Standardization, 1975.

⁴Irwin JD, and Graf ER, Industrial Noise and Vibration Control, Prentice-Hall, 1979: 59-61.

⁵Ontario Ministry of Labour, The Occupational Health and Safety Act, 1978. Art. 144. Also Proposed Regulations under the Act, Art. 4.

The above letter was referred to Dr. Finkelstein, who offers the following reply:

To the Editor

Mr. Behar has correctly pointed out some technical inaccuracies on my part. In writing the article, I chose to sacrifice rigour in an effort to make a technical topic as understandable as possible.

The important point that Mr. Behar raises has to do with the Equal-Energy Principle. As he has indicated, this principle is generally accepted in Europe, but is questioned by American audiologists. It is my opinion that the Equal-Energy Principle is supported by a body of epidemiological evidence and that because of its unifying and predictive powers it should form the theoretical basis for our efforts at hearing protection until such a time as it is replaced by a better theory. As far as I can tell, the American position and the 5 dB exchange rule are arbitrary and have very little justification. They are based upon the unsupported supposition that the hearing mechanism must make additional recovery during periods of quiet and that the Equal-Energy Principle and the 3 dB exchange rule are too restrictive; since 5 dB is less restrictive than 3 dB and since 5 is rather a popular digit, this number was plucked from thin air for the exchange rule.

It must be emphasized that the Equal-Energy Principle should only be applied to make predictions about the effects of noise on *populations* of workers – it is currently impossible to make any predictions about individuals.

To the Editor

Sir,

I read Dr. McEwan's Review of Occupational Exposure to Silica with great interest and even greater concern. There are a number of statements in the Review which bear critical examination and are more or less wholly incorrect. These relate mainly to the Vermont Granite Shed studies.¹⁻³ Dr. McEwan tells us the 'Epidemiological data sufficiently comprehensive and detailed to form the basis for a standard are limited mainly to one specific industry on this continent: the granite industry in Vermont.' I infer from this statement that she has accepted as valid the conclusions stated in this series of papers published by Theriault *et al.* If this is so, I am overcome with trepidation. There are a number of compelling reasons for rejecting the findings and conclusions of these papers.

First, the authors maintain that pulmonary function testing is a better way of monitoring silica exposure than is the chest x-ray. Yet it is known that most subjects with simple silicosis, including categories 2 and 3, have normal pul-

monary function, this despite the known presence of greatly increased silica content in the lungs.^{4,5}

Secondly, in the first series of papers we were told that the excess decrement in forced vital capacity of the granite shed workers was 2 ml per year. This figure was based on a cross-sectional study and a series of ingenious but contrived dust exposures for the various groups of workers. A follow-up longitudinal study concluded that the excess annual decrement in FVC due to dust was 35 ml per year.⁶ One might be pardoned for suspecting that one or other, or, more probably, both studies were incorrect. If this is not enough to raise a few doubts concerning the validity of the Theriault and Musk studies, perhaps the radiographic findings of simple silicosis in 40 per cent of workers who had never had any exposure to silica might conceivably have alerted at least a few impartial and disinterested observers. Clearly those who wrote the NIOSH criteria document which so enthusiastically endorsed the studies, were neither alert nor critical.

There are numerous other defects in these papers and at this stage there is little point in cataloguing them in detail but several years ago I called attention to a few of them.⁷ There are also excellent studies from elsewhere with diametrically opposite results.⁵ Moreover, Dr. William Graham of the University of Vermont has repeated the pulmonary function tests in the granite

shed workers and has shown that both the FVC and the FEV₁ have improved significantly over the past five years. Dr. Graham's study is to be published shortly and I have no wish to steal his thunder, but suffice it to say that his work completely invalidates the earlier studies.

The introduction of standards is a serious matter which may well have an appreciable economic effect on Industry as a whole and could under unpropitious circumstances lead to men losing their jobs. It is therefore necessary that all proposed standards should be based on the best available scientific and medical evidence, since otherwise they will do little to protect the workers' health and may well jeopardise his job. Ontario has a large investment in its Mining Industry; those concerned with the promulgation of standards would be well advised to form their own reasoned judgements rather than sheepishly accepting the tendentious and partial views expressed in many NIOSH criteria documents.

Yours truly,

W.K.C. Morgan, MD
Chest Diseases Unit,
University Hospital,
London, Ont.

References

¹Theriault GP, Burgess WA, DiBerardinis LJ, and Peters JM. Dust exposure in the Vermont Granite Sheds, Arch Envir Health 1974; 28, 12.

²Theriault GP, Peters JM and Fine LJ. Pulmonary function in granite shed workers. Arch Envir Health 1974; 28, 18.

³Theriault GP, Peters JM and Johnston WM. Pulmonary function and roentgenographic changes in granite dust exposure. Arch Envir Health 1974; 28, 23.

⁴Seaton A. Occupational Lung Disease, Chapter 7. Edited by Morgan WKC and Seaton A. Philadelphia: WB Saunders, 1975.

⁵Irwig LM and Rocks P. Lung function and respiratory symptoms in silicone and non-silicone gold miners. Am Rev Resp Dis 1977; 115, 769.

⁶Musk AW, Peters JM, Wegman DH and Fine LJ. Pulmonary function in granite dust exposure. Am Rev Respir Dis 1977; 115, 769.

⁷Morgan WKC. The walrus and the carpenter, or the silica criteria standard. J Occup Med 1975; 17, 782.

Dr. McEwan's response to Dr. Morgan's letter is printed below.

To the Editor

I am pleased to have the opportunity to respond to Dr. Morgan.

He has concentrated specifically on the results of pulmonary function studies in the Vermont granite industry, which have recently been re-evaluated.¹ Careful reading of my review shows that the conclusions stated in the series of papers by Theriault *et al.* were not considered pertinent. In fact, on page 11 he will find the statement that 'No quantitative conclusions can be drawn with respect to silicosis so this (first) study is not discussed further in detail.' The second and third studies in the series were reported for the sake of completeness, but as no valid conclusions could be drawn from them, they were not used in the final analysis.

Moreover, I was particularly careful in reaching my conclusions to take into

account that differing air sampling equivalents should be applied for different years in the Vermont granite sheds. Reference to Table 1 on page 25 illustrates this. The epidemiological studies by Russell² and by Ashe and Bergstrom³ state the results of radiographic findings at differing dust levels translated to give a gravimetric equivalent of respirable silica to measurements taken by impinger.

Other studies of workers exposed to granite dust (metal miners, foundry workers) are cross-sectional in nature and do not provide a basis for preparing dose-response relationships.

The diagnosis of silicosis in the studies by Russell and by Ashe and Bergstrom were made on the basis of radiographic findings and not on tests of pulmonary function. These represent the best available data, knowing that there may be shortcomings. Dr. Morgan's comments are therefore not relevant.

References

¹Graham WBG, O'Grady RV, and Dubuc B. Pulmonary function loss in Vermont granite workers. A long-term follow-up and critical reappraisal. *Am Rev Respir Dis* 1981; 123:25-28

²Russell AE. The health of workers in dusty trades — VII. Re-study of a group of granite workers. Federal Security Agency, US Public Health Service, *PHS Bull* 1941; 269.

³Ashe HB, and Bergstrom DE. Twenty-six years' experience with dust control in the Vermont granite industry. *Ind Med Surg* 1964; 33:73-78.

A New Emphasis in Engineering Education*

Summary

The roles of industrial hygiene and safety engineering in the field of occupational health and safety are outlined. The development, by the Department of Chemical Engineering and Applied Chemistry, University of Toronto, of a new program of instruction at the post-graduate level, the revision of the undergraduate chemical engineering curriculum and the provision of short, non-degree courses on specialized topics in response to manpower needs in the field of occupational health and safety, is described.

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M5S 1A4

Introduction

The term 'occupational health and industrial safety' embraces that part of medicine concerned with the diagnosis and treatment of occupational illness, the recognition and evaluation of hazards to health in the workplace (i.e. industrial hygiene), human factors engineering as it relates to man-machine interfaces, and that part of engineering, whether it be process or machine or product oriented, which is specifically directed towards the elimination or reduction of hazards in the workplace and the overall safe operation of the industrial plant. Inherent in this latter activity are the concepts of industrial hazard identification and control and loss prevention. There is, therefore, a continuous spectrum of activity ranging from the practice of medicine through the practice of industrial hygiene to the practice of design and control engineering in the broadest sense, all encompassed by the term 'occupational health and safety'. The emphasis in this paper is on manpower training in the industrial hygiene and safety engineering contexts - both of which are intimately related to sound chemical engineering practice.

While physicians are concerned with the health of worker patients and may recognize the causes of illness among workers, they are normally unable, because of training and staff role, to implement preventive and control measures. Preventive and control strategies which often, for example, involve process design and modification, local and general ventilation systems, the addition of abatement equipment such as gas scrubbers, material substitutions, and risk tree analysis, are the responsibility of engineers both as a consequence of their technical training and their management roles in industry. The Honourable Bette M. Stephenson, a physician and then Minister of Labour, Government of

*Paper presented at 30th Canadian Chemical Engineering Conference, Edmonton, Alberta. October 19-22, 1980

Ontario, recognized this when she opened the symposium 'Engineering Occupational Health':¹

'There has been a fundamental shift of priorities within the workplace. Workers are no longer willing to risk their physical health in exchange for financial reward. They expect, to quote Ramazzini, that they should be able to "exercise their callings without harm."

'That is what the working men and women expect – in fact, demand. Responsibility for fulfilling that expectation lies primarily with your profession and mine – the engineers and the physicians. But the engineering profession is no better equipped to fulfill its occupational health and safety responsibilities than is the medical profession.

'Look at the numbers. For every 100,000 workers in the United States, there are 30 qualified occupational health and safety specialists – hygienists, health and safety engineers, nurses and physicians. In Canada, we have three per 100,000 – one-tenth of the US level.

'To reach the level of 26 specialists per 100,000 workers (still below the US standard), Canada would have to add 2,530 professionals, including 702 engineers.

'Research indicates that there is an *immediate* need for 750 occupational health and safety professionals, 100 hygienists,² 300 nurses, 100 physicians and 250 health and safety engineers.

'Now that the engineering profession understands the need, it must re-evaluate its responsibilities and place far greater emphasis on occupational health and safety. It must apply its vast professional and technical expertise to the creation of a safer and healthier workplace.'

and

'If hazardous processes are to be eliminated, the engineer must accept his or her responsibility to:

- identify and monitor toxic chemicals
- control exposure to those chemical processes

¹'Engineering Occupational Health', a symposium sponsored by the Department of Chemical Engineering and Applied Chemistry, University of Toronto, Canadian Society for Chemical Engineering, the Chemical Institute of Canada and the Ontario Ministry of Labour, Toronto, April 13, 1978.

²Authors' note: Many of whom will inevitably have an engineering background.

- design less hazardous processes, using the principles of:
 - substitution of toxic chemicals with ones less hazardous
 - segregation of hazardous operations
 - proper materials handling or processing
 - local or general ventilation
 - personal protective equipment

‘Each role is, of course, important. However, I would suggest that your time and energy could be most productively expended in the third activity – process design. The need for pre-development review of planned operations is obvious. However, the review should not be restricted to new processes. Quite the contrary.

‘Existing facilities should be evaluated as well. I have no doubt that many chemical processing facilities are nothing short of occupational time bombs.’

A dimension of the problem not included in Bette Stephenson’s remarks is that of plant availability and the best use of capital investment. The prevention of accidents and major catastrophes which reduce the commercial viability of a plant is clearly also very important from a business point of view.

It must be recognized that tensions can easily arise between the medical and engineering professions in the context of occupational health and industrial safety. While the occupational physician is concerned with the health of persons at work, the engineer, in his design and management functions, is concerned with the production of materials and finished goods at the lowest possible cost. Engineers are therefore directly involved in the wealth generating capacity of a nation and its overall competitiveness. Inasmuch as the elimination or reduction of hazards may appear, at first glance, to add to the cost of production, the goals of the physician and the engineer may appear to be opposed. Society now expects a new balance in this respect, and engineers in their management and design functions must increasingly recognize the measurable costs associated with occupational illness, fatalities, accidents and lost production, which must be included in design optimization.

It is perhaps useful to cite an analogy to illustrate the impact that this trend is likely to have. The design

and construction of centralized municipal services, including safe water distribution systems and sewage treatment and disposal systems, has substantially improved the health of persons living in urban centres. Before these municipal services were designed and installed, physicians were able to determine the cause of disease, such as typhoid, propagated through unsanitary conditions. However, engineers were subsequently responsible for the drastic reduction, if not total elimination, of water-borne disease.

The main progress in the prevention of industrial illness, accidents and major catastrophes will be made by engineers. However, this will only be fully achieved in the longer term with a new generation of engineers who are sensitized and sympathetic to the need to include worker health and safety as a parameter in process design and operation, and the consequences of major accidents in the planning of industrial complexes.

The Department of Chemical Engineering and Applied Chemistry, University of Toronto, has, we believe, created a unique Canadian response to the need for trained manpower in the fields of industrial hygiene and safety engineering.

University of Toronto Program

In recognition of the importance of the industrial hygiene and safety engineering roles in the field of occupational health and safety, as out-lined above, the Department of Chemical Engineering and Applied Chemistry, University of Toronto, has developed a new program of instruction at the post-graduate level, strengthened the undergraduate chemical engineering curriculum, and is active in the provision of non-degree short courses on specialized topics. These activities, developed as a consequence of the growing public awareness and manpower needs in the field of occupational health and safety, are supported financially by the Ontario Ministry of Labour through a three-year manpower training grant over the period 1978-81. The experience of two academic years, 1978-79 and 1979-80, is, therefore, available and the third year, 1980-81, is now underway.

The primary thrust has been at the post-graduate level. Studies under the Master of Engineering degree (M.Eng.), the requirements for which are fulfilled by 8

courses and a project, meet the needs of both those with industrial experience and those new graduates with an interest to specialize in the field. The M.Eng. degree may be earned on either a part-time or full-time basis. The part-time approach is normally preferred by those who wish to continue employment in industry while earning the degree; many of the courses are therefore in late afternoon or evening time slots.

Two 'streams' exist within the post-graduate program: industrial hygiene, and occupational health and safety engineering. While there is, necessarily, overlap in course material for these streams, the background preparation and career objectives of the two groups do differ. A strong background in science, especially chemistry (often, but not necessarily, obtained in an undergraduate chemical engineering program), is necessary for the study and practice of industrial hygiene, while an engineering background (preferably chemical engineering) is recognized as preferable for the practice of occupational health and safety engineering.

Industrial hygiene is concerned with the recognition, evaluation and control of conditions likely to cause impairment of worker health or serious inconvenience to the worker. As such, it is less concerned with the traumatic injury resulting from an accident, and more with the effects of chronic exposure to low levels of hazardous substances and conditions.

The major aspects of safety engineering are the identification of hazards, the description of their fundamental mechanisms and specification of the necessary modifications to plant and/or process. Considerations include hazard assessment and risk evaluation applied to tasks and operations common to all industrial activity and to specific major hazards in the chemical and process industries. The all-important common feature with industrial hygiene is the underlying effort to quantify the salient features of failure mode and effect. Thus, in the control of hazardous conditions, industrial hygienists and engineering specialists have the same objectives.

The structure of the M.Eng. program for the 1980-81 academic year is summarized on page 116. There is a set of required courses, including a project

which is normally an independent study of a real problem, preferably carried out in an industrial setting. The courses, CHE 1406F 'Industrial Hygiene and Safety', and CHE 1416F 'Effects of Industrial Hazards', are designed to provide the essential fundamental understanding of hazards – chemical and physical – and their consequences for human health, and plant and system integrity. 'Basic Industrial Processes' is a course required for students who have a strong science background, but little or no engineering. 'Industrial Ventilation and Dust Control' stresses the importance of this topic for both the hygiene and engineering oriented students. 'Advanced Industrial Hygiene' and the associated laboratory course provide part of the necessary practical and field training required for the practice of industrial hygiene, while 'Major Hazards in the Process Industries' emphasizes the engineering aspects of industrial hazard control and loss prevention. Some 19 projects have now been completed (or are in progress) by M.Eng. candidates. A list of these is included in the Appendix from which it is clear that many members of the academic staff are contributing to the program. Beyond the required courses, elective courses are available to provide for the development of individual interests in the practice of engineering or industrial hygiene. These cover, for example, advanced analytical chemistry, fire and explosion hazards, safety in the nuclear power industry and associated uranium ore mining and processing plants and safety estimation and planning. In addition, courses offered by the Department of Industrial Engineering provide coverage of human factors, reliability engineering and plant layout.

The program is designed for those with an engineering or physical science background; however, students with a background in the life sciences will also be considered for admission provided that their knowledge of chemistry, their numeracy, and their motivation are judged to be more than adequate.

Over 40 students have enrolled in the M.Eng. program since it was launched in September 1978.

**Program for
M.Eng. Degree**

Students may specialize in Industrial Hygiene or Occupational Health Engineering. The program of courses for each is as follows:

Required Courses

- CHE 1406F Industrial Hygiene and Safety, *W.G. MacElhinney, J.W. Smith and J.H. Johnston*
- CHE 1416F Effects of Industrial Hazards, *M.A. Nazar, A.E. Robinson and M.V. Sefton*
- †CHE 1408F Basic Industrial Processes, *W.G. MacElhinney, O. Trass*
- CHE 1414S Industrial Ventilation and Dust Control, *H.D. Goodfellow*
- CHE 1417S Seminars in Occupational Health and Safety, *Co-ordinators: J.W. Smith, D.H. Napier*

Industrial Hygiene Program

- CHE 1419S Advanced Industrial Hygiene, and
- CHE 1420S Advanced Industrial Hygiene Laboratory, *J.W. Smith, J.H. Johnston*

Occupational Health Engineering Program

- CHE 1421S Major Hazards in the Process Industries, *D.H. Napier*

Project on industrial hazard control equivalent to 4 one-term courses.

†*Required course only for students with a non-engineering background.*

•*This course is a co- or pre-requisite for CHE 1420S.*

Elective Courses

- CHE 1202 Instrumental Methods of Chemical Analysis I, *S. Sandler*
- CHE 1203 Instrumental Methods of Chemical Analysis II, *S. Sandler*
- CHE 1401 Air Pollution Chemistry and Engineering, *C.R. Phillips*
- CHE 1402 Water Pollution Chemistry and Engineering, *C.R. Phillips*
- CHE 1403 Advanced Environmental Engineering, *C.R. Phillips, I.H. Spinner*
- CHE 1404 Radiochemistry in Environmental Analysis, *R.E. Jervis, J.H. Aitken*

- CHE 1405 Ionizing Radiation in the Environment,
*R.E. Jervis, D.G. Andrews, C.R. Phillips,
J.H. Aitken*
- CHE 1411 Fires and Explosions, *S. Sandler*
- CHE 1412 Advanced Analysis of Toxic Substances,
D.G.B. Boocock
- CHE 1413 Physical Chemistry of Aerosols, *C.R.
Phillips*
- CHE 1415 Safety Estimation and Planning, *D.H.
Napier*
- CHE 1418 Atmospheric Dispersion and Air Pollution,
J.W. Smith
- CHE 1419 Advanced Industrial Hygiene, *J.W. Smith,
J.H. Johnston*
- CHE 1420 Advanced Industrial Hygiene Laboratory,
J.W. Smith, J.H. Johnston
- CHE 1421 Major Hazards in the Process Industries,
D.H. Napier
- CHE 1500 Basic Applied Nuclear Process, *J.S.
Hewitt, J.H. Aitken, R.E. Jervis*
- CHE 1521 Nuclear and Radiochemistry, *R.E. Jervis*
- CHE 1524 Nuclear Instrumentation and Measure-
ment, *J.S. Hewitt*
- CHE 1525 Radiation Shielding and Radioactive Waste
Measurement, *D.G. Andrews*
- CHE 1535 Nuclear Reactor Safety Analysis and Con-
tainment, *D.G. Andrews*
- CHE 2502 Radiological Health-Measurements and
Protection, *D.G. Andrews*
- CHE 2503 Environmental Pathways, *D. Mackay*
- IND 1120 Reliability, *J.A. Buzacott*
- IND 1241 Human Factors in System Safety Engineer-
ing, *J.W. Senders, B. Samuel*

Additional post-graduate students are enrolled in the research oriented MASc and PhD degree programs. Here the research program constitutes the major component and the required course load is less substantial. Recent and current examples of MASc and PhD research projects include:

- A passive monitor for organic vapour hazards with instantaneous readout capability.
- Submicron deposition in models of a human lung bifurcation.
- A study of the determination of ambient oxidants using stable free radicals.
- Studies of the toxicology of hydrocarbons and halogenated hydro-carbons.
- Control of hydrogen sulphide in industrial gases.
- Design of flame arrestors.
- Gamma-camera for radiological surveys in reactor building.
- Measurement of the total and radioactive aerosol size distribution in a uranium mine.
- Gamma-camera developments and digital displays applicable to radiation imaging, including application in radiological survey.

While the main emphasis in program development has been at the post-graduate level, relevant material is steadily being introduced at the undergraduate level. Chemical Engineering offers a technical elective to first year students in the Faculty of Applied Science and Engineering. This elective includes a project in industrial hygiene. Two elective courses in Fourth Year Chemical Engineering emphasize the hygiene and engineering aspects of the field. They are 'Hazardous Substances in the Work Place' and 'Environmental and Occupational Engineering'. Formal exposure to a series of lectures on industrial hazard control is now also provided in the compulsory course 'Chemical Plant Design' in the fourth year. This undergraduate exposure will increase student awareness of the importance of the field, whether or not specialized post-graduate study follows completion of the BASc

Each member of the Chemical Engineering class (which typically ranges between 80 and 90 students at Toronto) also undertakes a final year 'thesis project'. During the last two years (1978-79 and 1979-80) some 32 students pursued projects in the industrial health and safety area. These are also listed in the Appendix.

The department has, with the assistance of senior advisers such as John Johnston (formerly of Imperial Oil

Limited), John Steel (University of Newcastle-upon-Tyne) and Ann Robinson (Ontario Ministry of Labour), developed a well equipped industrial hygiene laboratory. Metallic fume, organic vapours such as vinyl chloride monomer, inorganic gases such as hydrogen sulphide, and particulates such as silica and asbestos, are identified and analysed. Students are required to perform sampling and analysis of typical hazardous substances in at least one project conducted under field conditions, and to attend field trips in the latter part of their program. The facilities of this laboratory are also available to research students and, when not required for teaching, to the university and industrial community on a cost-recovery basis. The research dimension of the laboratory has been developed with the financial help of donors including Johns-Manville Canada, Dominion Foundries and Steel Limited, DuPont of Canada Limited, Ontario Hydro, Polysar Limited, Shell Canada Limited and General Motors (Canada) Limited.

Outside of formal degree programs, several symposia and short courses have been organized and presented. These include:

- 'Engineering Occupational Health', a symposium sponsored by the Department of Chemical Engineering and Applied Chemistry, University of Toronto, The Canadian Society for Chemical Engineering (Toronto section), the Chemical Institute of Canada (Toronto section) and the Ontario Ministry of Labour, Toronto, Ontario, April 13, 1978.
- 'Monitoring and Evaluating Occupational Health Hazards in the Workplace', a two-day Intensive Training Seminar sponsored by The Chemical Institute of Canada Environment Division and Canadian Society for Chemical and Biochemical Technology, in co-operation with The Department of Chemical Engineering and Applied Chemistry, University of Toronto and the Ministry of Labour, Toronto, Ontario, Dec. 3-4, 1979.
- 'Symposium on the Transportation of Hazardous Materials', sponsored by the Department of Chemical Engineering and Applied Chemistry, University of Toronto (in association with The Canadian Society for Chemical Engineering), and Oyez Limited, Toronto, Ontario, April 24-25, 1980.

- 'One-Week Intensive Workshop in Industrial Hygiene', Department of Chemical Engineering and Applied Chemistry, University of Toronto, Toronto, Ontario, May 5-9, 1980.
- 'Monitoring and Evaluating Occupational Health Hazards in the Workplace', a two-day Intensive Training Seminar sponsored by The Canadian Society for Chemical Engineering and the Canadian Society for Chemical Technology, in co-operation with the Department of Chemical Engineering and Applied Chemistry, University of Toronto, and Alberta Workers' Health and Safety, Edmonton, Alberta, May 12-13, 1980.
- 'Second Five-Day Intensive Workshop in Industrial Hygiene 1980', Department of Chemical Engineering and Applied Chemistry, University of Toronto, Toronto, Ontario, Sept. 29 - Oct. 3, 1980.

They provide opportunities for professional development for individuals unable to enrol in a conventional degree program. The workshops in industrial hygiene are intended to help prepare candidates writing the examinations of the American Board of Industrial Hygiene.

Program Development

The industrial hygiene stream in this program is well established, with some 10 individuals having completed the requirements for the master's degree and over 30 more working towards the degree. Many of these will subsequently qualify for comprehensive or specialist practice under the American Board of Industrial Hygiene certification scheme. It is expected that the hygiene stream will be strengthened by the introduction of more field work with the collaboration of local industries.

The five-day intensive workshop in industrial hygiene will continue on an annual basis and shorter specialist symposia will be held. Close relations with the profession will be maintained, and the ABIH certification and core examinations are now being run under departmental auspices.

The safety engineering stream is as yet less well developed. Through the development of courses and research the industrial hazard control and loss prevention aspects will be furthered by seeking clearer definition of hazards and the necessary precautions through

a better understanding of the fundamental processes involved. An example of such a hazard would be explosions of 'hybrid mixtures', i.e. flammable gas or vapours containing combustible dusts such as coal or flour. More emphasis will be placed on containment, layout and spacing of plant in design projects, coupled with better appreciation and use of reliability data. Inherent in this is the whole question of the acceptability of risk and the engineering profession's responsibility to workers and communities adjacent to industrial complexes. The cost effectiveness of hazard control must also be more clearly defined. Another important aspect which relates to both the hygiene and engineering streams in that of legislation and regulations. Instruction on the relevant parts of new provincial and federal legislation affecting, for example, health and safety at work and the transportation of hazardous substances is, we believe, necessary.

Early enrolments in the post-graduate M.Eng. program were local to Metropolitan Toronto. However, in 1980-81, the third year the program has been offered, enrolments have been drawn from across Canada. This growing national recognition is most encouraging.

M.ENG. THESES [Current, September, 1980]

Student Name	Thesis Title	Supervisor
Arnold, M.	<i>Tritium problems in the Candu reactor</i>	C.R. Phillips
Chen, S.L.	<i>Improved nuclear waste storage and transport methods</i>	D.G. Andrews
deFour, J.	<i>An evaluation of absorbents for mercury vapour</i>	J.W. Smith
Idler, K.L.	<i>Study of the adsorption of vapour phase mixtures of methyl ethyl ketone and styrene in activated charcoal tubes</i>	C.R. Phillips
Kalaba, T.	<i>Man-rem radiation expenditures in nuclear plant</i>	D.G. Andrews
Makselywich, W.	<i>Water absorption by welding fumes</i>	J. Steel
Maican, A.	<i>Identification of the breathing zone</i>	J. Steel
Steiner, M.	<i>Generation, evaluation and control of electrolytic tank room mists</i>	J.W. Smith
Maftai, S.	<i>Design and installation of a dust control system in a battery plant</i>	J.W. Smith

Projects for additional part-time students are being arranged.

Department of Chemical Engineering
and Applied Chemistry
Industrial Hygiene and Safety Engineering

COMPLETED M.ENG. THESES

Student Name	Thesis Title	Supervisor
Bergie, L.	<i>Deposition profiles of aerosols in filters</i>	C.R. Phillips
Collins, B.	<i>Study of a carbon-14 labelled reagent in a personal passive dosimeter</i>	D.G.B. Boocock
Jackson, A.C.	<i>Arsenic adsorption characteristics of various soil types</i>	C.R. Phillips
Karmali, S.	<i>An inexpensive activated charcoal passive monitor</i>	D.G.B. Boocock
Kostasas, H.	<i>Development of an X-ray fluorescence unit employing radioactive sources produced in the University of Toronto SLOWPOKE reactor</i>	J.S. Hewitt
Moledina, M.	<i>Iodine filtration</i>	D.G. Andrews
Morris, M.	<i>Industrial hygiene evaluation of a plating shop</i>	J.W. Smith
Mountford-Smith, T.	<i>Tritium reduction in heavy water</i>	D.G. Andrews
Robinson, T.	<i>Deposition of aerosols in lung models</i>	C.R. Phillips
Siu, H.	<i>Industrial hygiene evaluation of a flour mill</i>	J.W. Smith

**Department of Chemical Engineering
and Applied Chemistry
Industrial Hygiene and Safety Engineering**

COMPLETED B.A.Sc. THESES [1978-79]

Student Name	Thesis Title	Supervisor
Butsky, V.V.	<i>Mutagenicity of chlorinated compounds.</i>	W.H. Rapson
Dixon, P.	<i>Studies of hydrogen sulfide emissions from contaminated storage ponds.</i>	D. Mackay
Falls, J.A.	<i>Development of a foam monitor for hazardous vapours.</i>	M.V. Sefton
Guida, D.	<i>Emanation of radon from consolidated uranium mill tailings.</i>	C.R. Phillips
Hunter, J.	<i>Application of a colorimetric method in a nitric oxide dosimeter.</i>	D.G.B. Boocock
Kerametlian, V.J.	<i>Trajectory analyses of sulfur dioxide emissions in Ontario.</i>	D. Mackay
Kier, S.	<i>Hepatic encephalopathy.</i>	S. Sandler
Klenka, A.	<i>Internal combustion engine exhaust sampling.</i>	W.F. Graydon
Kwan, S.	<i>Determination of trace amounts of uranium in human urine.</i>	C.R. Phillips
Leung, A.	<i>An integrating radon monitor using CEA track etch detectors and a continuous working level monitor using alpha spectrometry.</i>	C.R. Phillips
Mann, J.L.	<i>The design and calibration of a plastic monitor for organic vapour dosimetry.</i>	M.V. Sefton
Murray, P.	<i>Sampling of fibrous particulates.</i>	M.E. Charles
Polgar, T.	<i>Mutagenicity of chlorinated compounds.</i>	W.H. Rapson
Roy, M.	<i>Design of a transportable scintillation monitor for measurement of total-body radioactivity in connection with environmental and health physics problems.</i>	D.G. Andrews
Silva, F.	<i>Study of the size distribution of arsenic fumes.</i>	J.W. Smith

Student Name	Thesis Title	Supervisor
Steiner, M.	<i>Study of hexavalent chromium in welding fume.</i>	J.W. Smith
Szeto, F.	<i>Apparatus for the preparation of precisely saturated solutions of sparingly soluble toxic compounds.</i>	D. Mackay
Ziegelheim, C.J.	<i>Instrumentation for the continuous monitoring of ^{226}Ra in water.</i>	C.R. Phillips

**Department of Chemical Engineering
and Applied Chemistry
Industrial Hygiene and Safety Engineering**

COMPLETED B.A.Sc. THESES [1979-80]

Student Name	Thesis Title	Supervisor
Bajor, O.	<i>Fusion 'tracer' studies - mapping radiation fields in possible fusion generators (protection of workers).</i>	D.G. Andrews
Carnwarth, C.	<i>Organic leaching of uranium ores.</i>	C.R. Phillips
Chen, R.	<i>Control of sulfuric acid aerosols in wet, electrostatic, and inertial scrubbers.</i>	J.W. Smith
Deason, G.	<i>Design and evaluation of an SO_3 detector.</i>	J.W. Smith
Dokurno, M.	<i>Fusion 'tracer' studies - mapping radiation fields in possible fusion generators (protection of workers).</i>	D.G. Andrews
Dominski, A.	<i>A study of an NO_2 colour tube as a personal passive dosimeter.</i>	D.G.B. Boocock
Hodgins, P.	<i>Reduction of radium levels in mill and refinery processes and wastes (reduction of radiation hazards to workers and public).</i>	D.G. Andrews
Kostas, A.	<i>A passive monitor for benzene dosimetry with continuous readout.</i>	M.V. Sefton
Lau, D.	<i>Determination of anions from acid mists by ion chromatography and UV detector.</i>	J.W. Smith
Leo, L.	<i>Measurement of uranium in biological specimens (safety of workers in fuel fabrication plant).</i>	D.G. Andrews
Mastracci, E.	<i>Preliminary field testing of the rubber dosimeter for organic vapour monitoring.</i>	M.V. Sefton

Student Name	Thesis Title	Supervisor
Pogorski, S.	<i>Radon emanation from soils.</i>	C.R. Phillips
Pringle, G.	<i>Boiling and burnout studies on nuclear reactor coolants (better operator control of nuclear reactor loss-of-coolant-accident and reduction of operator radiation dose).</i>	D.G. Andrews
Trevisan, S.	<i>Evaluation of the physical properties and evolution of welding fume and oxidizing gases.</i>	J.W. Smith

Health Effects of Polychlorinated Biphenyls*

Summary

The chemistry and metabolism of, and the environmental contamination by PCBs is briefly reviewed. The adverse health effects attributable to the Japanese Yusho incident are discussed and attention is drawn to the main occupational exposure effects – chloracne and liver damage.

Medical surveillance programs for workers who have experienced extra accidental or prolonged exposure are recommended.

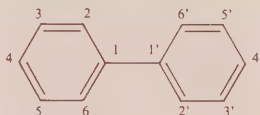
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Introduction

Chemistry and Uses

The polychlorinated biphenyls (PCBs) constitute a group of chlorinated aromatic hydrocarbons and are manufactured commercially by the progressive chlorination of biphenyl in the presence of a suitable catalyst.¹ This chlorination can lead to the replacement of from one to ten hydrogen atoms by chlorine. The conventional numbering of substituent positions is shown in Figure 1. PCBs are not a single entity, but are a complex multicomponent mixture with the weight-percent chlorine generally varying between 21 per cent and 68 per cent. Many commercial PCB products also contain substantial amounts of biphenyl, tri- and tetrachlorobenzenes and small amounts of many different chlorinated dibenzofurans, chlorinated naphthalenes and, for special uses, chlorinated terphenyls (three aromatic rings, e.g. Aroclor.² They have been marketed under various trade names since 1929 and have been used for a wide variety of applications. Since they are soluble in fat and exhibit a high degree of chemical and biological stability, they are now widespread contaminants in the global ecology.³ Considerable impact has been felt in both occupational and environmental settings. Their current use is restricted to closed systems in the electrical industry as insulating material in existing capacitors and transformers.

Figure 1



*Presented at the Ontario Hydro Safety Conference on December 2, 1980.

Metabolism

PCBs are readily absorbed through both the digestive tract and the respiratory system, but ingestion is not a usual route of entry in the workplace.⁴ They are lipid soluble and therefore can be readily absorbed through the skin. Varying amounts of unchanged PCBs are either stored in different organs, especially in fat depots, deposited in hair or excreted in feces, milk and, to a lesser extent, in urine. The remainder are metabolized to more water soluble compounds, which may then be eliminated in the bile, urine and milk.

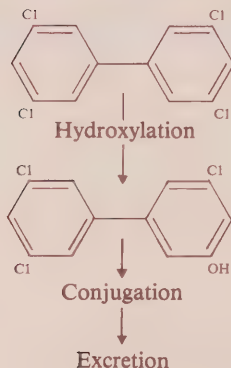
The metabolism appears to depend on both the degree and the pattern of chlorination. The lower chlorinated biphenyl compounds are more readily metabolized than the more highly chlorinated ones, with the result that the latter accumulate to a greater extent in the tissues, especially fat. As a consequence of this, some of the more highly chlorinated compounds persist in the tissues for years after intake has been discontinued.²

PCBs are metabolized in the liver by a specific enzyme system. This system is contained on the smooth endoplasmic reticulum (SER) and is known by several names including 'microsomal enzymes', 'mixed function oxidases', 'drug metabolizing enzymes' and P-450.

The principle metabolic reaction is hydroxylation. It may be direct (see Figure 2), or it may be through the formation of a very reactive intermediate, referred to as an epoxide or arene oxide, as shown in Figure 3.⁵

Most of the epoxide formed will be subsequently converted to the hydroxyl form, conjugated and excreted; but a small percentage, nevertheless, may react

Figure 2



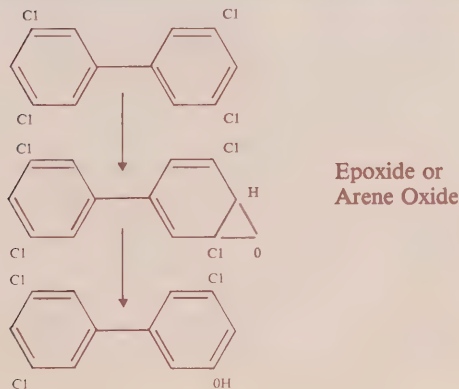
with macromolecules within the cell, including the DNA of the chromosomes and thus initiate mutation of the cell which may be malignant.

Environmental Contamination

The distribution of PCBs in the environment was not recognized until the 1960s. Since that time, investigations in many parts of the world have revealed a widespread distribution of PCBs in environmental samples.³ Just as PCBs are slow to disintegrate in the body, so they are highly stable in the environment, tending to bio-concentrate in food chains. They are present in ambient air, water and in many food stuffs. Therefore, they can be found in tissues and body fluids of a great many occupationally unexposed individuals.

Detectable concentrations ranging to 30 ppb have been found in up to 62 per cent of blood serum samples. About one third of these subjects showed adipose tissue concentrations in the range of from one to two ppm.⁶ PCB isomers corresponding to PCB types in the maternal blood have also been detected in cord blood of newborns and in human milk.³ While no obvious adverse effects have been associated with the above PCB concentrations, they demonstrate that workers may have substantial body burdens before the added insult of occupational exposure.² It is also important to stress that in spite of the Japanese experience to be discussed next and of occupational exposure reports, we do not know, with certainty, the lowest level that may cause symptoms or the highest level that is safe.

Figure 3



Much of the information about the effects of PCBs on humans has been obtained from the large-scale incident that occurred in 1968 in south-western Japan. From 14,000 to 15,000 persons were thought to have been exposed to PCBs, but only about 1,400 persons were diagnosed as having *Yusho disease*. The source of the contamination was determined to be a heat-exchange unit containing PCBs that leaked while rice bran oil was being heated under vacuum to remove odorous constituents. The major contaminant was found to be Kanechlor 400 and concentrations varied from 3000 ppm to traces. Minor contaminants included polychlorinated dibenzofurans at about 1/200 of the PCB concentration, traces of chlorinated naphthalenes and bromine at about two percent of the chlorine content. The oil was ingested by the population over a period of about eight months and it is estimated that the daily oral intake was about one to 15 mg of PCBs per person.

The earliest abnormal findings were cheesy secretions from the eye, swelling of the eyelids and pigmentation of the skin, nails and mucous membranes. As time progressed, the skin became thicker, with hair follicle enlargement leading to acneiform eruptions which were frequently associated with a secondary infection. These skin changes were most often seen on the neck and upper chest, but in severe cases, they extended to the whole body.

Other symptoms included tiredness, nausea, vomiting, abnormal menstrual periods and impotence. There were no definite signs of liver enlargement or liver disorders, but slight rises in serum transaminases and in alkaline phosphatase were detected. A liver sample from a Yusho patient showed an increase in the smooth endoplasmic reticulum. The serum bilirubin level of patients was found to be significantly below the normal level, apparently due to increased activity of liver enzymes induced by PCBs. Bilirubin was negatively correlated with the level of PCBs in the blood and with the serum triglyceride level.

The majority of the patients were found to have respiratory symptoms similar to those of a chronic bronchitis-like disturbance. In many cases, these persisted for several years, but no explanation for this was found.

Careful follow-up of all affected individuals during ensuing years showed that the eye and skin signs decreased and the chloracne healed, sometimes leaving scars. However, the non-specific neurological symptoms, general fatigue, anorexia, abdominal pain and headache tended to persist or become even more prominent among many patients. The slightly abnormal liver function also persisted: serum alkaline phosphatase increase, elevation of the triglycerides and decreased concentration of bilirubin in the serum. Autopsies performed a number of years later on these patients revealed liver injury. The most important findings were changes in the microanatomy of liver cells. This was considered to be indicative of microsomal enzyme stimulation. The maximum amount of PCBs consumed by individuals manifesting these effects was estimated to have been about three to four grams total intake over several months. The extent to which PCB consumption was responsible for the effects on the liver is not known since the contaminated oil also contained polychlorinated dibenzofurans (PCDF) in quantities that could have resulted in a maximum PCDF consumption of from 20 to 50 mg. Of the organs examined for PCB concentration, the liver and the heart usually contained quite high levels with only fat tissues being higher.

Babies of mothers who were exposed became known as 'black' or 'cola' babies because of the abnormal skin pigmentation that tended to persist for several months after their birth. Infants born up to five years after exposure were still affected to some extent. Some other clinical and anatomical abnormalities including retarded intrauterine growth, edematous face and exophthalmic eyes, dentition at birth, calcification on the skull in some, and wide, open sagittal sutures of skull in others, were seen at birth. The abnormalities were not permanent and postnatal body and mental development appeared normal in these and other Yusho children for the duration of known follow-up.

The Yusho disease episode is important because it established that PCBs could be transmitted in humans from the mother to fetus in utero and from mother to child through milk. It also demonstrated that some PCB compounds are eliminated from the body relatively rapidly, while others may require years for excretion. The Yusho episode's importance for the evaluation of occupational exposure to PCBs is compromised, however, because the oil was ingested and contained large concentrations of dibenzofurans as well.

Occupational Exposure

No immediate toxic effects from PCB occupational exposure have been observed except at concentrations approaching 10 mg/m^3 , which are unbearably irritating.⁸

The earliest reports of PCB toxicity related to workplace exposure are difficult to interpret. In most cases, the exposure levels were not specified and the concentrations of other impurities like chlorinated naphthalenes, although thought to be present in substantial amounts, were not known. Numerous cases of chloracne have been reported, which proved to be a major health problem.

It is interesting to note that chloracne can develop not only through direct skin contact, but also as a result of ingestion and respiratory exposure. The available data seem to indicate that chloracne may occur from several months' exposure to PCB vapour concentrations as low as 0.1 mg/m^3 and a PCB blood concentration of about 200 ppb.^{9, 10} However, there is much individual variation. The face is most commonly affected, but other areas like arms, neck and the rest of the body can be affected as well. Chloracne usually appears from two to eight months after the beginning of exposure and is frequently associated with hyperpigmentation of the skin.

Chloracne has been observed in Japanese people who were estimated to have ingested a total PCB dose of 0.3-4g.⁷

In animal toxicology, chloracne-like lesions have been produced in experimental rhesus monkeys fed PCBs at three ppm in their diets.¹¹

The other major concern relating to PCB exposure is the possibility of liver damage. There are many reports of impaired liver function attributable to occupational exposure to PCBs. The findings in Yusho patients and in animal studies indicate that some effects can, indeed, be expected from a PCB time-weighted average exposure of 1 mg/m^3 .^{7, 9} Some occupational exposure studies have shown evidence of liver injury at much lower levels, which might be due to individual susceptibility or to skin absorption. In the majority of the cases where chloracne developed, liver injury was found.

Because of the strict control measures in Canada, chloracne due to PCB exposure is almost unheard of.

Except for the very early fatality reports now attributed to chlorinated naphthalene contaminants, the liver abnormalities in most of the occupationally ex-

posed individuals were not striking. They usually reveal only slightly increased serum alkaline phosphatase, SGOT, SGPT, serum triglycerides and decreased total serum bilirubin.^{2, 10}

Other problems observed were digestive disturbances, non-specific respiratory complaints, irregular menstrual periods, impotence, skin and mucous membrane hyperpigmentation and interference with fat metabolism, including some of the fat soluble hormones.²

There is no clear evidence of carcinogenic, mutagenic or teratogenic effects resulting from the occupational exposure.

Animal Toxicity

Toxicological studies of PCBs on rats, mice, monkeys and other animals are numerous but, because of species difference, very difficult to interpret and correlate with human exposure. Some of the major observations from animal experiments have revealed carcinogenic, mutagenic and teratogenic effects of PCBs as well as an interference with hormone metabolism resulting in altered menstruation and interference with reproduction.

Inhalation and ingestion experiments at high enough concentrations have demonstrated increased liver weights and dose dependent cellular changes.¹² Neoplastic liver nodules, or hepatomas, have been produced in rats and mice. Some of these nodules were classified as hepatocellular carcinomas on the basis of histologic criteria.^{13, 14} There are no adequate studies to confirm or deny the carcinogenicity of PCBs in humans.

It has been well documented that PCBs can cross the placental barriers and are secreted in milk. They can affect the reproductive potential and cause temporary infertility, high abortion and postnatal death rates. Teratogenic effects were demonstrated in at least one animal study.² However, there are no reports of infertility or abortion attributed to human PCB consumption or exposure. Some undesirable effects were observed in children born to Yusho mothers exposed to PCBs in the diet,⁷ but during a prolonged follow-up of more than ten years, no teratogenic effects were found.

Threshold Limits

The American Conference of Governmental Industrial Hygienists, USA has set a Threshold Limit Value (TLV-TWA) for polychlorinated biphenyls (42 wt % of chlorine) at 1.0 mg/m^3 and for polychlorinated biphenyls (54 wt % of chlorine) at 0.5 mg/m^3 . However, in 1977, the National Institute for Occupational Safety and Health (NIOSH) had recommended a TLV-TWA of $1 \text{ } \mu\text{g/m}^3$ based on low dose studies in animals.² The suggested Ontario standard is also $1 \text{ } \mu\text{g/m}^3$. When considering threshold limits for PCBs, one should not forget the possibility of skin absorption.

Medical Surveillance

The type of medical follow-up for employees exposed to PCBs will greatly depend on whether the exposure was prolonged or accidental (of short duration).

A medical surveillance program for workers exposed on a long-term basis should normally include a pre-placement and annual medical examination, with special attention to diseases of the liver and skin. Laboratory investigation should include liver function tests, at least SGOT, SGPT and serum triglycerides. Although the recommended standard will prevent chloracne caused by inhalation, it is not known whether it will prevent other skin abnormalities. Therefore, considerable attention should still be given to the condition of the skin. A special problem is posed by women of child-bearing age because of the ease with which PCBs can cross the placenta. PCBs are excreted into the mother's milk and a real danger of neonatal exposure exists.

Health education on the hazards associated with PCBs should be provided for employees, including instruction in the use of personal protective clothing.

Employees working in situations where skin contact may occur should be provided with impervious clothing and gloves; goggles or safety glasses should also be provided if splashing is a possibility. Clean clothes daily and showers before leaving work are recommended; good personal hygiene must be encouraged at all times. PCB work areas should be well ventilated and checked for air and other contamination. Engineering techniques must be used to reduce the evaporation rate. This will be quite low because of its low vapour pressure. All exposures should be recorded and records kept for later reference.

The medical program for dealing with accidental exposure, such as spills, is more relevant in Ontario as accidental exposure is the greater potential danger. The first-aid treatment for each type of exposure is:¹⁵

- skin contact: wash thoroughly with soap and water.
- eye contact : irrigate with water for 15 minutes.
- inhalation : refer to company physician. If not available, refer to local physician.

Following exposure and the above-mentioned procedures, it is advised that workers should be periodical-ly examined by a physician. Examinations should be conducted as the attending physician deems necessary and may include the following¹⁶:

- 1) History } with attention being directed to liver disease
 } and
- 2) Physical } skin condition
- 3) Serum bilirubin
- 4) Protein electrophoresis and total protein
- 5) Hepatitis B surface antigen
- 6) Complete blood count
- 7) SGOT and SGPT
- 8) Gamma-glutamol transpeptidase (GGT)
- 9) Alkaline phosphatase

This group of tests is required to determine two possible conditions:

- 1) Prior liver disease, which needs to be established in the event of a subsequent claim being made by the patient, and because of possible worsening of the condition.
- 2) Acute, reversible or irreversible, liver damage caused by the exposure.

Normally, follow-up tests should be conducted three months after, and one year after, the initial tests. If the tests remain negative, surveillance may be discontinued.

As a result of news media publicity, a great deal of public anxiety and fear now exists over the use of PCBs in the workplace, accidental exposure to PCBs and PCB contamination of the biosphere. Biospheric contamination by PCBs is mainly due to the persistence of the material in the environment and its negative impact on wildlife. There is no denying that this is most undesirable and needs to be controlled and reduced.

However, the contamination is not of sufficient intensity to justify widespread anxiety and fear.

Moreover, the adverse health effects are transient, except in the case of possible liver damage. Although there is a potential for carcinogenicity and teratogenicity, as demonstrated in animals, this must be viewed in perspective and over-reaction should be avoided.

Today, a PCB spill regrettably generates as much alarm as would a case of smallpox or cholera suddenly appearing in a community. This is surely quite irrational, since death amongst contacts is not immediate, delayed or inevitable.

To expect a quick return to sanity in either the public's behaviour pattern or in its reaction to PCB spills is improbable, but those of us who are better informed must continue striving to ease the public's fear. The risk from PCB contamination and subsequent adverse health effects warrants concern, but, most certainly, not alarm.

Acknowledgements

The assistance of Dr. J. Budlovsky, Dr. S. Guirguis and Dr. D. Harding is acknowledged.

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Summary

The difficulties facing small businesses in providing adequate occupational health and safety services are described. The occupational health hazards most likely to be encountered in small businesses are briefly discussed. Services which should be provided by an occupational health program are listed and several suggestions for organizing and administering such a program are offered.

About 80 per cent of the Canadian labour force works for businesses which employ fewer than 100 employees.¹ It is this segment of the workforce which is least likely to have knowledge of, or access to, occupational health services. The provision of adequate occupational health and safety services for small business is difficult, not only in Canada but in all Western industrial countries.² There are three major problems.

First, owners, managers, supervisors and workers are generally unaware of the health hazards which are present in the workplace and of the value of preventive measures.³ Compounding this general lack of knowledge is the fact that there is a high concentration of hazardous industries among small businesses. In the construction industry, for example, 90 per cent of the firms employ 20 or fewer workers.⁴ Although construction accounts for only five per cent of total employment, it is the second most hazardous industry⁵ and has 20 per cent of the work-related accidents in the United States.⁶ There is also a large proportion of small businesses involved in manufacturing, processing or the use of hazardous substances.⁷ Within industries, smaller firms tend to be more hazardous than larger firms.⁸

The second problem for small businesses is that reducing workplace hazards is more expensive for them than for large firms. It may be that the least expensive way to protect workers' health in many businesses is available only to production units above a minimum size. All firms below this size must pay more per worker to provide a given level of protection. Thus, the small firm probably cannot spread the costs of hiring a full-time safety and health specialist over a sufficient volume of production to pay for his services.⁹

The third problem is the cost to small firms of implementing the health and safety standards and regulations required by The Occupational Health and Safety Act of Ontario.¹⁰ In general, small firms tend to be in an unstable competitive situation. Any small economic setback may lead to failure; being faced with the additional cost burden of improving occupational health

and safety may force many small firms out of business.¹¹

To summarize, the marginal nature of small business and the high cost of compliance necessitated by the full enforcement of adequate standards may put them in an economically untenable situation.¹²

Occupational Hazards in Small Business

It is difficult to establish a profile of the type and frequency of occupational hazards found in small business since these factors tend to vary from industry to industry. Several studies, however, provide an overview of the occupational hazards which are most likely to be encountered. In their investigation of physical and chemical hazards in 99 small workplaces in Finland, Heikkilä *et al*¹³ found that preventive measures were needed most frequently for noise (63 per cent of the firms surveyed), illumination (43 per cent), vibration (20 per cent) and thermal conditions (10 per cent). Altogether, 42 per cent of the total number of employees surveyed were exposed to a noise level possibly hazardous to hearing and 28 per cent required an audiometric examination. Solvent vapours and organic dusts, the most common chemical hazards, required preventive measures in 38 per cent and 17 per cent of the firms, respectively.

Pekkarinen *et al*¹⁴ investigated occupational safety in 84 of the 99 small Finnish workplaces also examined by Heikkilä. Pekkarinen evaluated the risk factors in the work environment, in materials handling and in the use of equipment, but excluded occupational hygiene factors such as noise and light. It was found that 60 per cent of the firms had a 'substantial hazard' rating in the work environment and 56 per cent in materials handling. About 20 per cent of the technical equipment recorded was defective in comparison to safety guides.

In their investigation of occupational safety and health services in manufacturing and processing firms in North Dakota, Bender and Eelkema¹⁵ found that more than 60 per cent of the employees were exposed to an average of four potential hazards. As a result of size, only 15 per cent, 11 per cent and 9 per cent of the firms employed an industrial hygienist, physician or nurse, respectively. However, 50 per cent of the firms indicated they had formal occupational safety and health programs.

These three studies provided evidence of the numerous hazards present in the small businesses' work environment, as well as the need for increased monitoring

of the work site, enforcement of standards and occupational health education programs for owners and employees.

The Occupational Health Program

Occupational health is concerned with the maintenance and promotion of health in the work environment and the prevention of disease as a consequence of occupation. Occupational health practice involves a multidisciplinary team which may include physicians, nurses, occupational hygienists, engineers, physicists, chemists and safety officers. The International Labour Organization (1959) defined an occupational health service as 'one established at or near a place of employment' and which pursued the following goals:

1. Protecting the workers against any occupational health hazard,
2. Contributing towards the workers' physical and mental adjustment,
3. Establishing and maintaining the highest possible degree of physical and mental well-being of the workers.¹⁶

To attain these goals an occupational health program should provide the following services regardless of the size of the business to be served:¹⁷

1. *Preplacement medical examinations* will establish the health status of new employees and assist in suitable job placement. Much of the examination can be conducted by questionnaire, with a nurse interviewing and undertaking routine screening procedures such as urinalysis, vision testing and audiometry.
2. *Primary treatment* of occupational injuries or illnesses is the only therapeutic role for plant health services in Canada and should be undertaken with due regard to the employee's regular family physician relationship. Primary treatment, if available, can reduce morbidity and absenteeism, thereby contributing to overall company productivity.
3. *Monitoring the hazardous environment* requires regular plant inspection and evaluation of work conditions and environment by physical, chemical and biological measurements. Measurement should be selective, periodic, designed according to the industrial process involved and limited to the employees who are at risk.

4. *Identification of unrecognized hazards* demands a combination of clinical observation and epidemiological investigation. About 3,000 new chemicals are put on the market annually¹⁸ and, although they are tested before distribution, the final test of safety can only be made after human exposure. The major concern is the potential of a chemical to be carcinogenic alone or in combination with other compounds. There is a long latent period before cancer develops following chemical exposure and, consequently, the recognition of carcinogenic properties is often delayed.
5. *Supervision of workplace hygiene* entails the surveillance of hazardous materials, especially in areas designated for eating or resting, and periodic inspection to ensure adequate heat, lighting and ventilation.
6. *Screening* to monitor changes in the health of employees and detect the early occurrence of an occupational illness. The screening techniques used will depend on the industrial processes in use at a plant and will reflect known relationships between occupation and morbidity.
7. *A medical records system* containing detailed medical information is necessary for job placement, health maintenance, workmen's compensation and rehabilitation, establishing health standards and epidemiologic studies.
8. *Rehabilitation of employees* following an illness or injury may include the retraining or relocation of an employee in a new job, or machine adaptation for an employee.
9. *First aid training* is mandatory for as many employees as possible and is available through the St. John Ambulance Association.
10. *Assessing the suitability of protective clothing and safety devices.*
11. *Advising management* on hazards to health and safety in the workplace. The physician in charge must have a knowledge of the work site, the processes being undertaken, the chemicals being used and their physical and toxicological properties and the habits of the labour force. Consequently, frequent visits to the site and discussions with employees and supervisors are required.

12. *Health education and counselling* will aid the prevention of accidents, injuries and occupational disease and promote a positive attitude towards health.
13. *Research* might be required to ensure that the above functions can be achieved.

Organization and Administration of Program

The efficient provision of medical services requires a large minimum company size; consequently, individual small businesses cannot bear the total cost of an occupational health program. Several alternative ways of organizing a program have been suggested:

1. A co-operative/joint program between several small industries in a compact area, operated by a staff of occupational health nurses and laboratory and clerical personnel under the supervision of one or more physicians and with access to the services of an industrial hygienist. The program should also provide for plant visits by the physician and on-site consultation with specialists when needed.¹⁹
2. A clinical group practice with a 'fee for service' system of remuneration.²⁰
3. A program to serve many plants *via* mobile units having x-ray and laboratory screening services, history taking and medical examinations.²¹ The Slough Industrial Health Service in the United Kingdom employed a mobile unit equipped as a treatment and examination facility.²² The vehicle-mounted facility enabled the medical and nursing staff to move from plant to plant and work from an adequately equipped office and treatment room when such facilities were not, or could not be, provided at the plant itself.
4. A program which provides the services of a physician who works for several plants.²³
5. A provincial program administered by a provincial commission. This system of organization is found in the province of Quebec where the provision of occupational health services has become a provincial responsibility.²⁴ The Commission of Occupational Health and Safety prepares occupational health programs for specific geographical territories or businesses. The commission establishes contracts with every hospital centre where there is a community health department so that the hospital will provide the services necessary for the implementation of the occupational health programs in the ter-

ritory or businesses identified in the contract. The physician in charge of health services for a firm must prepare a specific health program for that firm and the program must be submitted to the firm's health and safety committee for approval. In addition, a copy of the program for each company must be transmitted to the commission and to the head of the community health department. Health services are provided in the plant or in the hospital centre.

In addition to the medical services supplied by the program, a health education and counselling service should also be available. A co-operative effort among firms, unions, trade associations or special interest groups in one industry could offer this service through workshops, speeches, audiovisual materials, on-site consultation and continuing education programs.

The Occupational Health and Safety Act of Ontario places the responsibility for occupational health and safety on the management and employees of all companies, regardless of their size. The regulations formulated under the Act establish high hygienic standards for the workplace and often require strict medical controls. Individually, small businesses will have difficulty providing the quality controls that are now mandatory under the Act.

Most large companies in this country operate efficient occupational health services well staffed by appropriately trained physicians, nurses and hygienists. Companies spend large amounts of money on their services and ensure that standards of health and safety are high. The statutory requirements of The Occupational Health and Safety Act are unlikely to effect major improvements on the quality of occupational health services available to employees of these companies, many of which already operate at, or beyond, the required standards. If, therefore, the new legislation has to improve the provincial level of health and safety in the workplace, it must make its impact felt among the 75 to 80 per cent of the employed persons who currently do not enjoy the quality of working environments found in large companies. The burden of responsibility under the new Act and regulations must, inevitably, fall on small businesses.

The extent to which small business does, or can, implement the provisions of the new legislation will determine the level of improvement in occupational

health and safety which Ontario can achieve during the next decade.

To conclude, insufficient knowledge of occupational hazards and control measures and the prohibitive cost of supplying occupational health services are the major barriers to be overcome before adequate occupational health and safety services will be available to small businesses. Co-operative efforts between businesses could give them access to services at a reduced cost, but even then it is unlikely that an adequate service can be viable without substantial subsidy.²⁵

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The Ontario Ministry of Labour Library

Summary

Occupational health library reference services of the Ontario Government are described from 1920 to present on-line computerized data base searches.

The library of the Ontario Ministry of Labour has a large collection reflecting the broad areas of ministry responsibilities – industrial relations, employment standards, manpower, human rights, employment of the handicapped, quality of working life and women's issues, as well as the entire field of occupational health and safety covering industrial, construction, mining and the extended coverage areas of The Occupational Health and Safety Act.

The main library is at 400 University Avenue, Toronto. The collection consists of approximately 80,000 books and reports and 1,500 journals and newsletters; about 40 per cent of these cover occupational health and safety and related biomedical, engineering and technological material.

There is a staff of 17, of whom six are professional librarians; the reference librarians are subject specialists as well as information scientists. The library is primarily a resource and service for ministry staff throughout the province, although non-ministry persons may use material in the library and limited assistance is given as time permits. The library's reference service should not be confused with the ministry's Information Branch which looks after ministry publications and news releases or with the walk-in Information Service which answers the public's questions about the ministry's own programs.

The library's occupational health reference service depends on both a comprehensive historical collection and access to a large selection of modern computerized data bases.

The occupational health component of the library's collection was started in 1920 by the Industrial Hygiene Division of the Ontario Department of Health and has been maintained continuously for sixty years, making it one of the most complete collections available anywhere. Later, the library was known, for a number of years, as the Technical Reference Centre of the Environmental Health Services Branch of the Ministry of Health and was located at 1 St. Clair Avenue West. The library's subject coverage was expanded to include

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environmental health, health effects of pesticides and radiation protection. An article by B. Smiley¹ in the *Ontario Library Review* in 1971 contains a description which still fits present service: 'The Library provides the background information and searching service which help to make the Branch activities a tremendous asset in the fight against pollution and in the continuing endeavour to make Ontario a safer place in which to live and work.' The article also mentions library budget problems, serious overcrowding, the need for 400-500 interlibrary loans a month - all familiar problems to present staff.

Shortly after moving to its new spacious quarters at 1 St. Clair Avenue West, a Ministry of Health reorganization in 1973 necessitated another move. The Technical Reference Centre and the library of the Ontario Hospital Services Commission were amalgamated in a new location at 15 Overlea Boulevard which, a year later, was enlarged to accommodate the main Ministry of Health library collection. The occupational health collection continued to form a significant component of the new library. However, in 1977, as a result of new occupational health and safety legislation in Ontario, the Occupational Health Protection Branch was transferred to the Ministry of Labour and the whole occupational health library collection was packed up and moved once more - a little the worse for wear, but still essentially intact! This time the move was to its present location at 400 University Avenue, where it was integrated into the Ministry of Labour library which had a large collection of material on industrial safety. In addition to the main library, there are small satellite library collections at the Sudbury Mining Office, the Occupational Health Laboratory and the Radiation Protection Laboratory.

The present collection includes all of the main occupational health and safety journals, indexes, abstracts, newsletters, loose-leaf services, data sheets, books, reports, proceedings and government documents in English and a selection of material from France, Germany, Sweden, Russia and Japan. In addition to coverage of all known Canadian documents, there is a collection of all of the International Labour Office publications, all relevant World Health Organization publications, including those of the International Association for Research on Cancer, most of the publications of the Health and Safety Executive of Great Britain, and of the US National Institute for Occupational Safety and Health, Bureau of Labor Statistics,

Occupational Safety and Health Administration, Mining Safety and Health Administration and Environmental Protection Agency Office of Toxic Substances. Other collections include publications of the National Safety Council, the National Academy of Sciences, the American Industrial Hygiene Association, the American Conference of Governmental Industrial Hygienists and the Swedish National Institute for Occupational Health. The library also has a large selection of standards from the Canadian Standards Association, the American, British and International Standards Associations, the National Fire Protection Association, the Canadian Underwriters' Laboratory, etc. The library's collection includes over 14,500 indexed pamphlets, reports and reprints from 1900 to 1980. Some of historical interest include reports of the British Industrial Fatigue Board set up during the 1914-1918 World War to investigate conditions in munitions factories.

Journal articles have been indexed by subject content continuously since 1920 and there are now over 200,000 index cards in these catalogues. About 500 entries per month are still being added for current journal articles. These files are both much older and also more current than any printed or on-line indexes and are the basis for much of the library's reference services.

The earliest journal articles in occupational health were from general medical journals such as the *British Medical Journal*, but beginning with the *Journal of Industrial Hygiene* in 1919 (now the Archives of environmental health), specialty journals in the field began to appear and the Ministry of Labour library has been fortunate in having most of these from volume 1. These include:

<i>Archives of Environmental Health</i> (formerly <i>Journal of Industrial Hygiene</i>)	vol. 1, 1919-
<i>Occupational Health and Safety</i> (formerly <i>Industrial Medicine</i>)	vol. 1, 1932-
<i>British Journal of Industrial Medicine</i>	vol. 1, 1944-
<i>Occupational Health Nursing</i> (formerly <i>American Association of Industrial Nurses Journal</i>)	vol. 1, 1946-
<i>Occupational Health in Ontario</i>	vol. 1, 1948-

<i>Occupational Health</i> (formerly <i>Journal of Industrial Nurses</i>)	vol. 1, 1949-
<i>Journal of the Society of Occupational Medicine</i> (formerly <i>Assoc. of Industrial Medical Officers Transactions</i>)	vol. 1, 1951-
<i>Annals of Occupational Hygiene</i>	vol. 1, 1958-
<i>Health Physics</i>	vol. 1, 1958-
<i>Journal of Occupational Medicine</i>	vol. 1, 1959-

This indexing of early journal literature in occupational health is important since the excellent coverage from the card index of the International Information Centre for Occupational Health and Safety (CIS) of the International Labour Organization in Geneva was not started until 1960 and the earliest computerized data bases were not available until 1966.

A selection of current journal indexing together with new books and reports are listed in library bulletins which are circulated to ministry staff and a few other libraries and organizations as a current awareness service. The library staff also publish short bibliographies – Topics in Occupational Health and Safety – on subjects of current interest.

Although the library's own indexing still provides much of its reference service and has the advantage that all material is immediately available in the library, in recent years, on-line access to computerized data bases has changed the whole approach to locating information. A recent article by Kiechel² provides an interesting overview of modern on-line information technology from the user's point of view. The general requirements are computer readable data bases, massive random access storage devices (hardware), search programs (software), communications networks, and user terminals. There are literally hundreds of data bases available to any organization with a computer terminal, a trained searcher, and a contract with a vendor. Most data bases are available through vendors who supply a series of data bases under contract to the user using the same search commands, or strategy, for each of the bases. Most search strategies involve the use of Boolean logic, combining the 'and', 'or' and 'and not' concepts. Some data bases are available from more

than one vendor using different search programs and sometimes at different costs. Data bases are of two general types.

Bibliographic data bases provide references to journal articles; in most cases, these are the familiar printed indexes transferred to on-line format such as the engineering index, chemical abstracts, biological abstracts, safety science abstracts and index medicus (known on-line as MEDLINE).

MEDLINE, which has a fixed thesaurus, is useful for information about occupational diseases since this is one of the fixed terms that is used. MEDLINE is an extremely large file of bibliographic references. Only the last four years can be searched directly on-line and the preceding years are available for off-line printing only in a series of backfiles. The on-line portion contains about 750,000 references and the backfiles over 2,500,000 references. TOXLINE and CANCERLINE are also useful for industrial toxicology and occupational carcinogenesis.

Kissman,³ reviewing on-line searching in toxicology, estimated that there were 33 million bibliographic references on-line in 1976. By 1978, the number had grown to 55 million. Present estimates and probable growth are truly staggering. One problem that small libraries are facing in addition to the increasing hourly costs of searches, is the need to obtain journal articles referred to in these bases, often foreign material difficult to locate. Most large libraries are already charging fees for interlibrary loans, up to \$8.00 per item in some cases. Some vendors provide for on-line ordering of articles, but again, for a sizable fee and, in the United States, copyright fees may have to be added to photocopy charges. The costs of searching and borrowing are making information retrieval an increasingly expensive process.

A second kind of data base, the *non-bibliographic data base*, or data bank, is common in the business world – airline information, bank balances, stock quotations, are everyday examples – but in science they are just beginning to appear and, no doubt, will multiply rapidly in the future. There are three very useful data banks in the MEDLINE system: CHEMLINE, RTECS and the Toxicology Data Bank. CHEMLINE is an on-line chemical dictionary containing records for over 400,000 substances. It provides the chemical abstract registry number, synonyms, the molecular formula and an indicator showing which NLM data bases the compound may be found in. RTECS is the on-line

version of NIOSH's Registry of Toxic Effects of Chemical Substances with about 41,000 substances and is updated quarterly. The Toxicology Data Bank is a very detailed data bank from the Oak Ridge National Laboratory's Materials Toxicology Data Center. There are fourteen fields to each record, containing chemical, manufacturing, toxicological, environmental and other information about hazardous chemicals. The information is obtained from secondary and tertiary sources and is subjected to peer review of experts before it is included. This is a very complete data bank, but because of the time required to prepare these records, there are only about 2,600 complete records in the bank.

One anomaly of reference service that librarians are very conscious of, but which is probably not recognized by their clients, is the fact that no information takes longer to find than voluminous material. A conscientious librarian will sometimes spend hours looking in every possible location before reporting that nothing can be found.

In recent years in Ontario, a number of occupational health and safety libraries have been developed with excellent coverage of current literature and, in some cases, with on-line searching facilities. They can now fill most of their clients' requests and this has helped to take some of the pressure off the Ministry of Labour library, leaving it to serve as a back-up resource for Ontario's need for in-depth and historical material while meeting the ministry's own increasing information needs.

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Publications Available from Government Book Store

Publications under the Regulation Act vol. 112-39

O. Reg. 658/79 as amended by O. Reg. 844/79 Industrial Establishments	\$1.50
O. Regs. 659/79 as amended by O. Reg. 845/79 Construction Projects	\$1.50
O. Regs. 660/79 as amended by O. Reg. 846/79 Mines and Mining Plants	\$1.50
The Nursing Consultant	\$2.00
A Guide to The Occupational Health and Safety Act, 1978	\$1.00

News and Notes

Occupational Health Clinical Unit, University of Toronto, at St. Michael's Hospital, 30 Bond Street, Toronto, Ontario M5B 1W8.

Director — Dr. J.R. Nethercott, MD, FRC (C)

Relevant Information:-

1) *Location:*

The clinic is located on the 3rd floor of the 'D' south wing of St. Michael's Hospital. The hospital is located at the corner of Queen and Victoria Streets.

2) *Hours:*

Patients are seen in the clinic between the hours of 9 a.m. and 12 noon on Mondays and 1 p.m. and 4 p.m. on Fridays.

3) *Patients Accepted:*

Patients are accepted on the basis of referrals from physicians as well as from their representatives, their employers or self-referral.

4) *Clinic Staff:*

Staff members include physicians who are members of the following university departments: The Department of Preventive Medicine and Biostatistics, Department of Medicine (Dermatology, Respiriology, Clinical Immunology, Neurology), Otolaryngology, Ophthalmology, Family and Community Medicine and Education Psychology.

- 5) *Special Facilities Available:*
Facilities are available for epicutaneous testing, pulmonary function tests, cutaneous tests for allergy, audiology, specialized visual testing, psychological testing, biochemical investigations, radiology, field investigations to make measurements in plants related to physical and chemical parameters within the environment.
- 6) *Specialized Services:*
In co-operation with the Faculty of Engineering, consultants are available to provide information on the development of new engineering designs to reduce environmental exposures found, through investigations, to be hazardous.
- 7) *To Arrange Appointments:*
Appointments may be arranged by calling (416) 360-4335 between the hours of 9 a.m. and 5 p.m. daily and there is a 24-hour answering service on this line for emergencies.

Lottery Grants for Occupational Health and Safety Programs in Ontario

Lottery grants of nearly one million dollars have been announced for occupational health and safety education and training. Included are grants of \$90,000 to each of the Occupational Health and Safety Resource Centres located at the University of Western Ontario, the University of Waterloo, Queen's University and Lakehead University.

The Resource Centres, first established in 1978, provide a wide range of information, education and consulting services on matters of occupational health and safety to employers and employees in their local communities. Co-operation and co-ordination between the centres ensures quick access to authoritative health and safety information across the province.

Also included are grants to the University of Toronto and McMaster University.

The University of Toronto will receive \$239,000 for the continued support of undergraduate and post-graduate health and safety programs in the Faculty of Applied Science and Engineering and the Faculty of Medicine.

McMaster University will receive a grant of \$261,000 which will assist in the Faculty of Medicine's occupational health and safety program.

The two universities will continue to work in co-operation with each other to co-ordinate their training activities. The programs of these two institutions contribute in an important way to the supply of trained professionals on which the efforts of both government and the private sector in occupational health and safety depends.

Academy of Medicine, Section of Occupational Medicine, Toronto

This section had not met since 1956/57, but under the chairmanship of Dr. D. Warren it was reconvened for the 1980/81 session and has had a very successful year with meetings as follows:-

- October 16 — Communication Between Physicians
- November 20 — The Preplacement Medical
- January 15 — Determining Fitness to Drive a Motor Vehicle
- February 25 — The Doctor as a Witness
Joint Meeting with Academy of
Medicine, Hamilton
- April 16 — The Compensation Case
- May 22 — Section Dinner

Next year's program is being arranged and the provisional dates for meetings are as follows:

- October 1, 1981
- December 3, 1981
- January 7, 1982
- February 4, 1982
- April 1, 1982
- Section Dinner — June 3, 1982

Membership will permit attendance at all section meetings, use of library and participation in all club activities. Membership application forms are available from Miss M. Wilson, 288 Bloor Street West, Toronto, Ontario, M5S 1V8, Telephone (416) 922-0074.

Occupational Health for Physicians

The University of Toronto, Faculty of Medicine is offering a Short Course in Occupational Health, October 19 - 23, 1981 in Toronto.

This is the first of a series of courses particularly designed to meet the needs of part-time physicians in industry.

Topics Will Include:

The Practice of Occupational Medicine. Toxicology. Biostatistics and Epidemiology. Health Effects of Physical Agents. Ergonomics. Laws and Regulations. Industrial Hygiene. Industrial Disease. Current Issues in Occupational Health.

Approval of the course for study credits for Continuing Education, College of Family Physicians of Canada may be obtained.

Registration Fee: \$250.00

For applications and further details write to:
The Director
The Occupational and Environmental Health Unit
The Faculty of Medicine
University of Toronto
150 College Street, Toronto, Ontario M5S 1A1
Tel. (416) 978-4353

Coming Events

August 16-19, 1981	International Symposium on Education and Training Policies in Occupational Safety and Health and Ergonomics. Organized by the Directorate of Labour Inspection of Norway in collaboration with the ILO and the WHO. Further information may be obtained from the International Labour Office, Occupational Safety and Health Branch, CH-1211, Geneva 22.
September 2-4, 1981	2nd International Environment and Safety Conference, Wembley, England.
September 25-30, 1981	20th International Congress of Occupational Health, Cairo, Egypt. For further information write to Professor Dr. Mahmoud Hassanein, Cairo University, 32 Falaki Street, Cairo.
October 4-9, 1981	2nd World Congress of Chemical Engineering and IX Interamerican Congress of Chemical Engineering, Montreal, Quebec.
October 19-23, 1981	Ontario Occupational Health Nurses' Association, 10th Annual Conference, London, Ontario.
October 25-29, 1981	47th Annual Scientific Assembly, American College of Chest Physicians, San Francisco. Further information may be obtained by writing to the American College of Chest Physicians, 911 Bussye Highway, Park Ridge, Illinois, 60068.
October 29-30, 1981	Society of Occupational Medicine, Autumn Meeting and AGM., London, England.
November 11-14, 1981	Quebec/Ontario Occupational Health Physicians' Meeting, Montreal, Quebec.
November 23-25, 1981	2nd International Congress on Analytical Techniques in Environmental Chemistry, Barcelona, Spain.



**Ontario
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Labour**

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